CLAIMS

1. A system for electroplating a semiconductor wafer comprising:

a first electrode in electrical contact with the semiconductor wafer, the first electrode and the semiconductor wafer forming a cathode during electroplating of the semiconductor wafer;

a second electrode forming an anode during electroplating of the semiconductor wafer;

a reaction container defining a reaction chamber, the reaction chamber comprising an electrically conductive plating solution, at least a portion of each of the first electrode, the second electrode, and the semiconductor wafer contacting the plating solution during electroplating of the semiconductor wafer;

an auxiliary electrode disposed exterior to the reaction chamber and positioned for contact with plating solution exiting the reaction chamber during cleaning of the first electrode to thereby provide an electrically conductive path between the auxiliary electrode and the first electrode;

a power supply system connected to supply plating power to the first and second electrodes during electroplating of the semiconductor wafer, the power supply system further connected to render the first electrode an anode and the auxiliary electrode a cathode during cleaning of the first electrode.

2. A system as claimed in claim 1, wherein the second electrode is disposed substantially entirely in the plating solution of the reaction chamber and the first electrode comprises at least one conductive finger which supports a semiconductor wafer as the semiconductor wafer, the at least one conductive finger being

positioned to support the semiconductor wafer so that only one side of the semiconductor wafer contacts the surface of the plating solution in of reaction chamber during electroplating thereof.

3. A system as claimed in claim 1, wherein the auxiliary electrode is disposed in an outlet tube that accepts the plating solution after exiting the reaction chamber.

4. A system as claimed in claim 3 and further comprising a control valve disposed to control plating solution flow through the outlet tube as it flows toward the auxiliary electrode.

5. A system as claimed in claim 3, further comprising a particulate filter disposed to filter residue from the plating solution after exiting the plating bath.

6. A system as claimed in claim 1, and further comprising a reservoir container, the reaction container disposed at least partially in the reservoir container, plating solution exiting the reaction chamber flowing into the reservoir container.

7. A system as claimed in claim 6 wherein the auxiliary electrode is disposed in the reservoir container.

8. A system as claimed in claim 7, wherein the auxiliary electrode is disposed in an outlet tube that accepts plating solution exiting the reservoir container.

9. A system as claimed in claim 8 and further comprising a control valve disposed to control plating solution flow through the outlet tube as it flows toward the auxiliary electrode.

10. A system as claimed in claim 6 wherein the reservoir container is attached to a plating solution outlet tube comprising a particulate filter.

11. A system as claimed in claimed 1 wherein the second electrode is a consumable anode and wherein the system further comprises an anode shield positioned to shield the anode from direct or oblique impingement by flowing plating solution.

12. The system of claim 11 wherein the anode shield is made of a dielectric material.

13. A method for operating a system used to electroplate a semiconductor wafer, the system comprising a first electrode for contacting the semiconductor wafer, a second electrode functioning as an anode during electroplating of the semiconductor wafer, an electrically conductive plating solution disposed in a reaction chamber, and an auxiliary electrode disposed exterior to the reaction chamber and a fluid flow path of plating solution exiting the of reaction chamber, the semiconductor wafer and first and second electrodes being in contact with the plating solution in the reaction

chamber during electroplating of the semiconductor wafer, the method comprising the steps of:

providing a flow of plating solution from the reaction chamber to the auxiliary electrode to create an electrically conductive path between the first electrode and the auxiliary electrode;

applying electrical power between the first electrode and the auxiliary electrode in which the auxiliary electrode functions as a cathode and the first electrode functions as an anode to thereby remove at least a portion of a metal electroplated onto the first electrode during a prior semiconductor wafer electroplating operation.

14. The method according to claim 11 and further comprising the step of passing the plating solution containing removed plated deposits through a particulate filter.

15. The method according to claim 12, further comprising returning the filtered plating bath solution to the reaction chamber plating bath.

16. An apparatus for use in electroplating a semiconductor wafer, the apparatus comprising:

a fluid cup having a cup bottom and cup sides, said fluid cup further having a fluid inlet for communicating a flow of electroplating solution into the cup;

a consumable anode disposed within said cup in a fluid flow path of electroplating solution flowing from the fluid inlet;

an anode shield disposed with respect to the anode to protect the anode from direct impingement of a flow of electroplating solution flowing from the fluid inlet.

17. An apparatus as claimed in claim 16 wherein the fluid inlet is disposed in the cup bottom and provides a generally vertical flow of electroplating solution into the fluid cup.

18. An apparatus as claimed in claimed 17 wherein the anode shield is disposed to protect a bottom surface of the anode from direct impingement of the flow of electroplating solution flowing from the fluid inlet.

19. An apparatus as claimed in claim 17 wherein the anode shield is connected to the anode to protect a bottom surface of the anode from direct impingement of the flow of electroplating solution flowing from the fluid inlet.

20. An apparatus as claimed in claim 19 wherein the anode shield is connected to an anode adjustment assembly that is adapted to selectively adjust the height of the anode within the fluid cup.

21. An apparatus as claimed in claim 16 wherein the anode shield is made from a dielectric material.

22. An apparatus for electroplating a semiconductor wafer, the apparatus comprising:

a reservoir container having a bottom and sides;

a fluid cup disposed within said reservoir container so as to form a fluid flow region extending about the periphery of the fluid cup between the fluid cup and the sides of the reservoir container, said fluid cup further having a fluid inlet disposed therein for communicating a flow of an electroplating solution into the fluid cup, electroplating solution flowing into the fluid cup ultimately flowing into the fluid flow region as it overflows from the fluid cup;

an anode disposed within said cup , the anode being spaced from and overlying the cup bottom;

a fluid cup leveling mechanism for leveling the fluid cup to ensure a generally uniform flow of electroplating solution about the periphery of the fluid cup into the fluid flow region.

23. An apparatus as claimed in claim 22 wherein the fluid inlet is disposed in the cup bottom to communicate a generally vertical flow of electroplating solution into the fluid cup.

24. An apparatus as claimed in claim 23 where in the anode is a consumable anode, the apparatus further comprising an anode shield connected to the anode to protect a bottom surface of the anode from direct impingement of the flow of electroplating solution flowing from the fluid inlet.

25. An apparatus as claimed in claim 24 wherein the anode shield is connected to an anode adjustment assembly that is adapted to selectively adjust the height of the anode within the fluid cup.

26. An apparatus for electroplating a semiconductor wafer, the apparatus comprising:

a reservoir container having a bottom and sides;

a fluid cup disposed within said reservoir container so as to form a first space between said fluid cup and said sides of said reservoir, said fluid cup having a cup bottom and cup sides, said cup further comprising a fluid inlet disposed within said cup so as to admit electroplating solution into said fluid cup;

an anode disposed within said fluid cup such that said fluid inlet is between said cup bottom and said anode, said anode defining a second space between said anode and said cup sides; and

wherein electroplating solution rising within said cup may overflow about said second space, through said first space, and into said reservoir container.

27. An apparatus as claimed in claimed 26 wherein the reservoir container and the fluid cup are circular in cross section.

28. An and apparatus as claimed in claim 27 wherein the anode is generally circular and wherein said first and said second spaces are annular in shape.

29. An apparatus as claimed in claim 26 and further comprising a cup height adjustment mechanism connected to the fluid cup for adjusting the height of the fluid cup relative to the bottom of the reservoir container.

30. A method for plating a semiconductor wafer with a metal, the method comprising:
providing a bath of an electroplating solution, the bath having an upper surface;
lowering the semiconductor wafer toward the bath until a first planar surface of the semiconductor wafer contacts the upper surface of the bath; and
raising the semiconductor wafer away from the upper surface of the bath so as to generate a meniscus between the bath and the planar surface of the semiconductor wafer;
providing a current flow through the electroplating solution between the anode and the semiconductor wafer to thereby electroplate the metal on the planar surface of the semiconductor wafer.

31. A method as claimed in claimed 30 and further comprising the step of rotating the semiconductor wafer about a vertical axis after generating the meniscus.

32. A method for in-situ cleaning a semiconductor electroplating electrode to remove at least one plating metal from the surface of the electrode, said electrode being used to conduct current between a semiconductor semiconductor wafer and an electroplating electrical power supply to facilitate plating of the at least one plating metal onto the semiconductor semiconductor wafer, said electroplating electrical power supply

applying electrical current to said electrode using a first polarity, the method comprising:

removing any semiconductor semiconductor wafer from a semiconductor semiconductor wafer support which includes the electrode as part thereof;

placing the electrode into a plating liquid;

passing a reverse electrical current between the electrode and said plating liquid using a second polarity which has a reverse polarity to said first polarity, said passing current causing the metal plated onto the electrode to be dissolved into the plating liquid.

33. A method for operating a semiconductor electroplating apparatus, comprising:

placing a semiconductor semiconductor wafer in a semiconductor wafer support, said semiconductor wafer support including at least one electrode which contacts the semiconductor semiconductor wafer to conduct electrical current therebetween;

placing at least one surface of the semiconductor semiconductor wafer into a plating liquid;

electroplating at least one plating metal onto said at least one surface of the semiconductor semiconductor wafer during a normal operating cycle, said electroplating including charging a plating liquid and the semiconductor semiconductor wafer to differing voltages which have a first polarity relationship;

removing any semiconductor semiconductor wafer from the semiconductor semiconductor wafer support;

placing the at least one electrode into the plating liquid;

passing a reverse electrical current between the electrode and said plating liquid using a second polarity which has a reverse polarity to said first polarity, said passing current causing

metal plated onto the at least one electrode to electrochemically dissolve into the plating liquid.

34. A semiconductor wafer processing station, comprising:

a plurality of process bowls, each said process bowl having a bowl bottom and bowl sides;

a process fluid reservoir having a reservoir top, said reservoir top containing plurality of openings for receiving each of said process bowls therein;

a plurality of fluid cups, an individual one of each said fluid cups being disposed within a corresponding individual one of each said process bowls, so as to form a first space between each said fluid cup and said each bowl sides, each said fluid cup having a cup bottom and cup sides, each said fluid cup further comprising a fluid inlet disposed within said cup so as to admit fluid into said cup; and

wherein each said bowl bottom is in fluid communication with said reservoir such that fluid rising within said cup may overflow about said first annular space into said fluid reservoir.